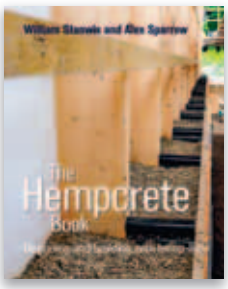
Reviews...

REVIEW BY NEIL GARRETT



The Hempcrete Book

Designing and building with hemp-lime

By William Stanwix and Alex Sparrow

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See adjacent for an extract from this book

What the second little pig should have known

Rather than build a house of sticks the second little pig should have read the new book by William Stanwix and Alex Sparrow titled ***The Hempcrete Book*** and built his house of hemp.

This book clearly explains to the little piggy that the house would not only be strong and resist attack by wolves, white ants, rats and mice but would be warm and cosy in the winter, cool in the summer, beautiful, easy to build, natural, sustainable, local and have low embodied energy and even be carbon negative.

What else would a little piggy want in a sty

Sandy and I embarked on the journey to owner build a sustainable hemp house in Violet Town, Victoria in 2013 and are currently in the final stage of the build. Like the little piggy we would loved to have read this book before starting our build.

We avidly read the inspirational book by Steve Allin titled ***Building with Hemp*** and the publication by Bevan and Woolley titled ***Hemp Lime Construction***, went to the first *'Hempcrete'* hemp building course in Maleny with Steve Allin, to gain information on how to build with hemp and undertook many internet searches under chanvre (French for hemp). We also visited two projects: an extension and a full house build, to gain practical knowledge. How we wish that we had access to this book by Stanwix and Sparrow before we started.

The book explains that the hemp lime construction concept was developed in France in the 1980s to effectively restore Tudor style houses following failed early attempts using cement. These authors are recognised to be the UK's leading advisors in the use of hempcrete, regularly speaking at conferences and exhibitions such as Grand Designs, featured in magazines and writing articles. This book will become a practical manual for the building of hemp-lime buildings and the use of lime renders and plasters.

This book is suitable for architects, designers, builders and owner builders. It explains how to mix hempcrete and how to build with it. It provides a full explanation of construction techniques, highlighting potential pitfalls and how to avoid them. It includes examples of completed builds with design notes. It also has some inspirational photos of hemp buildings and processes. The design notes are invaluable and would have been saved us much time and energy as we grappled with the details of hemp construction.

Any architect, designer, owner or builder thinking of building in hemp or using lime in their build should obtain this book before they start. We, along with the relatives of the second little piggy, wish we had that opportunity. ◆

Hempcrete terrace at a housing association development in Diss, in Norfolk, constructed from cast-in-situ hempcrete around a timber frame.

*(From page 92, **The Hempcrete Book**)*

Book extract... *'The Hempcrete Book'*

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Structural qualities

A large number of studies have looked into the structural properties of hempcrete, in a range of applications and using a variety of testing methods. Perhaps unsurprisingly, the results show a wide range of values for the structural performance achieved.

Hempcrete on its own

There is an issue regarding the suitability of assessing hempcrete using current methods for testing the structural performance of masonry and mortars, since hempcrete does not fail in the same way as these materials do. Instead of cracking or fracturing under compression, hempcrete fails by deforming – bending out of shape, with some recovery towards its original shape when the load is removed. Further investigation into the positive implications of hempcrete's ability to deform without breaking, in the context of the movement of buildings, would be worthwhile.

The main focus of research into hempcrete as a structural material has been in relation to pre-cast blocks, which are sometimes described as either 'thermal' (lower density) or 'structural' (higher density). In order to achieve blocks with the degree of compressive strength needed for load-bearing applications, a significant increase in hempcrete density is required. Since this is achieved by increasing the proportion of binder in the mix, sometimes with the addition of some cement and/or sand, increased structural performance can only be gained at the cost of some insulative value (which is the primary reason for the use of hempcrete) as well as an increase in the material's embodied energy. Therefore the normal use of hempcrete in blocks is as thermal blocks – used, as with cast-in-situ hempcrete, to infill around a structural frame.

There is little data on, and, to the authors' knowledge, no examples in use of, structural cast-in-situ hempcrete other than in floor slabs, nor have there been any studies to date on the effects of ageing on the structural performance of hempcrete, although it is thought that higher-density hempcrete is likely to age better than lower-density mixes.

Owing to the unique mechanical properties of hempcrete, blocks still need to be cast around a structural frame.

Hempcrete combined with a timber frame

While not suitable for structural applications in isolation, there is no doubt that as part of the typical build-up of structural timber frame with hempcrete cast around it (or as infill), the material does perform an important structural role. Once fully hardened, hempcrete provides racking strength to the frame structure – adding significantly to its ability to resist lateral movement as a result of external forces, such as wind loading – and thereby removing the need for the timber diagonal braces traditionally used for this purpose. In fact, according to Amziane and Arnaud, the hempcrete infill provides almost ten times as much racking strength to the frame than does timber diagonal bracing. It also significantly reduces the amount of deformation the structure exhibits in the event that the frame does eventually break.

Book extract...

In construction practice, this ability of hempcrete to brace a timber frame has the advantage of reduced timber requirements (in terms of the number and size of diagonal braces, as well as the number of horizontal noggins for general rigidity). It also reduces the time spent on frame construction, since the diagonal braces are the most time-consuming frame element to construct and fit.

As hempcrete is a non-load-bearing insulating material cast around a structural frame, building control inspectors have little interest in it from a structural point of view, simply requiring that it meets fire regulations, levels of thermal performance, and acoustic insulation requirements as mandated by the relevant Building Regulations. However, when it comes to convincing building control inspectors that reinforcing and bracing frame members can be omitted from the structural frame, as the hempcrete provides this function, they start taking more of an interest. We have had varying success in convincing structural engineers and building control officers of hempcrete's properties in this regard, and have often been forced to include at least some diagonal timber or stainless-steel bracing, despite this being clearly unnecessary. Engaging a structural engineer who understands the material and/or an Approved Inspector (see Chapter 12, page 149) can be important in helping to make the case.

There is a need for the development of a protocol for testing the structural performance of hempcrete, to encompass appropriate tests which take into account the fact that hempcrete is a very different material in its performance from other masonry products. Such a testing procedure would also need to accommodate different shiv and binder materials, mix ratios and application techniques within the methodology. This would be a step towards enabling better comparison between individual studies in future.

Fire resistance

The formal testing of the fire-resistance properties of hempcrete has been limited; carried out mainly on proprietary products (both pre-cast and cast in situ) to test compliance with national regulatory regimes. However, the density and nature of hempcrete, with the plant-derived component encased within its lime binder, means it is very difficult to set fire to it. Moreover, the standard detail of cast-in-situ hempcrete encasing a timber frame means that the hempcrete forms a barrier between the timber structure and any fire.

Bevan and Woolley[1] cite fire testing carried out in France on a 250mm-thick wall of hempcrete blocks laid in lime mortar. The wall remained intact for 1 hour 40 minutes, although the mortar joints failed. No re-ignition or emission of toxic gases was noted. It is assumed that a solid cast wall of hempcrete would offer a superior fire resistance. These authors also comment on the fact that while the hemp shiv is flammable in its loose form, hemp does seem somewhat less flammable than comparable materials in some of its other forms, for example as hemp paper.

In terms of the resistance of cast-in-situ hempcrete to fire, Daly et al. report that the BRE Group in the UK carried out:

> a fire resistance test on a 3m x 3m Tradical® Hemcrete®, non-rendered or plastered, wall in accordance with BS EN 1365-1:1999. The wall was subject to a vertically imposed load of 135kN and was cast from layers of hemp–lime mix, poured into a mould, and included eight vertical timber studs. The internal face of the wall was exposed to the fire and it resisted for 73 minutes in respect to integrity, insulation, and load-bearing capacity.[2]

The same authors note that testing undertaken by the French manufacturer Isochanvre produced results that indicated that hempcrete is a "non-flammable material", with fire-resistance performance improving over time as the binder continues to carbonate (this time factor depends on the composition of the binder: see Chapter 16, page 215).

In a conversation with ourselves, Graham Durrant of The Limecrete Company provided anecdotal evidence which appears to support this finding. A fire that broke out in a rooftop upstand on the Sustainable Enterprise Centre at Bradford University, shortly after it was constructed, resulted in damage to the timber cladding but not the hempcrete. The structure was a twin-frame design, with the structural timber frame on the internal face of the wall, and an external, non-structural frame to support the timber cladding. The cladding burnt away, as did the cladding battens and the supporting frame sank flush in the face of the wall, but the hempcrete itself and the structural frame on the inside face did not combust.

Further research is needed, particularly into the effects that various factors (different binders, varying the mix ratio, and the presence of render and plaster finishes) have on hempcrete's fire resistance. However, the data currently available suggest that hempcrete is suitable for applications where fire resistance of 60 minutes is required, and that this might easily be increased to 90 or 120 minutes' fire resistance with alterations in the specification.

1 Bevan, R. and Woolley, T. (2008) Hemp Lime Construction: *A guide to building with hemp lime composites.* IHS BRE Press: Bracknell (page 75).

2 Daly, P., Ronchetti, P. and Woolley, T. (2013) *Hemp Lime Bio-composite as a Building Material in Irish Construction.* Environmental Protection Agency Ireland: on line only. http://erc.epa.ie/safer/iso19115/displayISO19115.jsp?isoID=202 (page 44).

Focus on self-build 1: Agan Chy

Inheriting a field with a dilapidated concrete barn on it gave Bob and Tally Moores an opportunity to fulfil what was, for Bob at least, a long-held dream of building his own house. Planning permission had been refused on the barn once, but after some detective work Bob and Tally found an old map which convinced the council that, contrary to previous opinion, the barn sat within the village boundary, and permission was eventually granted for demolition of the barn and construction of a house.

Bob is a carpenter, used to timber framing, so his house was always going to be based around a green oak frame, and having worked for a supplier of traditional and environmentally friendly building products, he was familiar with lime and other natural materials. He was doing an MSc in Sustainable Architecture at the Centre for Alternative Technology, from which he says he learnt a lot, but couldn't understand why everyone was talking about easy-build bolt-together timber-frame houses with lightweight insulation, which needed to be sealed up tight to keep the heat in and then ventilated using mechanical systems to maintain indoor air quality. Bob says, "Up to the point when we built the house, I had lived mainly in vernacular buildings, built from local, natural materials that had stood the test of time. I wanted the same feeling of permanence from the house I was going to build myself... to know that, as well as being a high-thermal-performance eco-house, it would stand a chance of being there for centuries to come, and I didn't think I would get that from a lightweight insulated timber-frame house." The more Bob thought about it, the more it seemed to him that thermal mass was the key to passively storing heat, whether created by heating systems or from the sun, and slowly releasing this energy to maintain a constant comfortable temperature inside.

The final design included a green oak structural frame, with a softwood studwork frame built off this to take the hempcrete. The principles of passive solar design were followed: highly efficient glazing on the south-facing elevation and a minimum of windows on the north side, together with a good overhang so that the windows are shaded in summer but allow direct sunlight in during the winter, when the sun is lower in the sky. All the external walls are 300mm hempcrete, with additional thermal mass provided by a deeper-than-usual concrete floor slab and slate floor covering in the open-plan living area. The roof is insulated using wood-fibre insulation panels. Being in an exposed location close to the Atlantic coast in north Cornwall, Bob and Tally have sensibly used a larch rain-screen cladding over the hempcrete on the exposed walls (most of the house); on the south side, they used a breathable render. Bob's motto for the build was 'Low-tech – high performance', and this comes out in the solidity and strength of the materials that surround us as we stand in the kitchen: oak posts and beams, solid black slate flooring, black slate windowsills, lime plasters and thick hempcrete walls. The house, on a scorching July day, feels reassuringly cool and comfortable, despite the fact that we are sitting next to the large south-facing windows and the external doors are open, allowing a direct connection with the heat outside.

In the winter, heating is provided by a wood burner in the living room, the flue of which passes through the master bedroom on its way to the roof, allowing the passive transfer of heat into the bedroom. There is a solar domestic hot water system, and an air-source heat pump to supply underfloor heating, but Bob and Tally find that they hardly ever need to use it. Even in very cold winters, the heat from the wood burner alone is more than enough to maintain a comfortable temperature throughout the house "at least 90 per cent of the time – and to be honest a lot of the time we probably have it on for the atmosphere rather than heating. The only time we turn the heating on is when we've got guests in the spare bedroom and we feel we should heat up the 'north wing' for them," says Bob.

Bob designed the house with architect Roderick James, and the hempcrete details were worked out by Bob

Book extract...

1. Agan Chy.
2. 'Solid and built to last,' yet light and airy.
3. Larch cladding was used as a finish for the hempcrete.
4. Natural materials complement each other at Agan Chy: natural slate sills and roof covering, and lime renders or larch cladding over hempcrete.
5. Warm in winter and cool in summer, despite the large windows, due to hempcrete's unique thermal performance – insulation *and* thermal mass – together with the passive solar design.

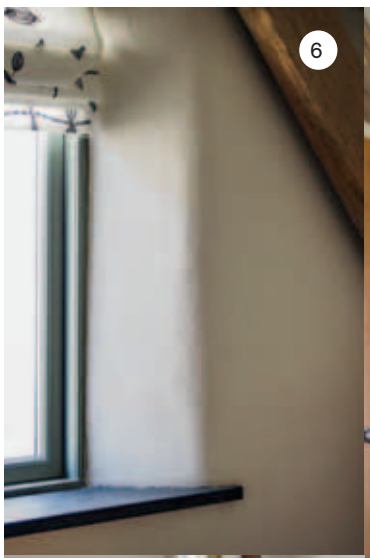
together with Chris Brookman from Back to Earth, who supplied the hempcrete. The build took eight months of full-time work, and another eight months part time. A friend, Ollie, worked with Bob on the construction of the frame, and then Bob and Tally finished the rest of the build by themselves. Bob says he found the hempcrete easy: "It's great to work with – putting up the shuttering was the hardest bit." He enjoyed the low-tech nature of hempcrete as a material, and found it refreshing being a pioneer doing something that not many others had attempted at the time, and so being able to "make it up as I went along" – a pleasant change from conventional construction.

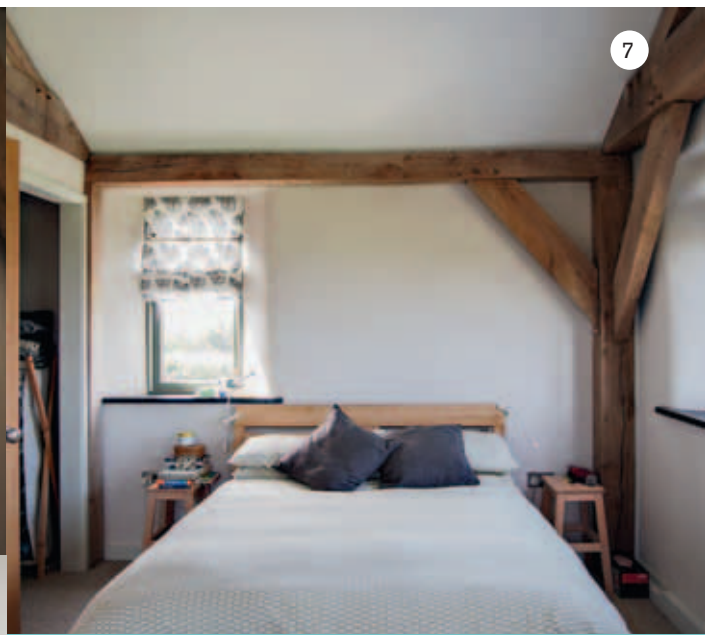
At the time, Bob worked out what it would have cost to build the house out of brick-and-block, and "it was pretty much the same – and that includes the 'cost' of my own labour, but if you think of the advantages from the thermal performance of hempcrete there's no comparison". Bob and Tally found that using hempcrete brought no disadvantages in terms of getting a mortgage, and there were no issues with planning either. For building control they used an Approved Inspector, and would recommend this to others: "Because he was directly employed by us, he took the time to listen and understand the material and what we were doing, and instead of being suspicious of something out of the ordinary he was interested and really got behind the project."

Reactions from friends and family have been interesting: "In the early stages, lots of people

were curious, if not openly amused," Bob says, "but once they have experienced what it feels like to be in the house, they all get it. Everyone is blown away by it." Bob's musician friends particularly enjoy the acoustics created by the solid hempcrete. "Not being a musician, it's an aspect of the material I'd never really thought about," says Bob, "but they rave about it." Anyone wishing they could experience the feel of a hempcrete house for themselves can do so, if they fancy a summer holiday in Cornwall, as Bob and Tally rent their house out for eight weeks of the year.

Following completion of the build, Bob was surprised to get a personal call from the energy assessor who had visited their house. "He said that he never rang people up, but he was calling to advise me to get an airtightness test done, because ours was one of the most thermally efficient houses he had ever assessed, and with favourable airtightness results it might put our rating up from A+ to something even higher – the very highest rating, which only a very few buildings in Europe ever achieve." Bob has not in fact had an airtightness test carried out, as, "I didn't feel it was worth spending the money, and because we wanted to use passive ventilation we've got trickle vents. I'm not really interested in super-airtightness if it means using powered mechanical heat-recovery ventilation systems; anyway, we're happy with how it performs – it's warm in winter and cool in summer, and it achieves my criterion of feeling like a solid house – something that's built to last!" ✳





6. Curved window reveals accentuate the natural feel.
7. Lime plaster and windows on three sides give the master bedroom a light, soft atmosphere.
8. The wood burner is the only heating Bob and Tally need most of the time.
9. The stove pipe passes through the bedroom, making use of the flue itself for additional heating.
10. Traditional, natural materials are used to create a building with a contemporary feel at Agan Chy.
11. Bob outside his hempcrete home.